REPORT ON SWEETPOTATO WEEVIL INVESTIGATIONS DURING 1941

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This report summarizes the results of the investigations on the sweetpotato weevil (Cylas formicarius subspecies elegantulus Summers) obtained at Sunset and Baton Rouge, La., during 1941. The principal objectives of these investigations have been: (1) To obtain additional data upon certain biological phases which may have a direct bearing upon control. (2) A further study of wild hosts and their relation to weevil breeding and perpetuation. (3) Obtaining further information on flight and dissemination, with special reference to the effect of climatic conditions upon dispersal, and further data upon migration from fields. (4) Determining the possibility of controlling the weevil through chemical treatment of fields. (5) Developing effective and economical implements and methods of field cleaning. The work was conducted in cooperation with the Louisiana Agricultural Experiment Station, the Louisiana Department of Agriculture and Immigration, and the Division of Control Investigations of the Bureau of Entomology and Plant Quarantine.

Biological Observations

Identification of Weevils: Sweetpotato weevils that had emerged from Ipomoea hederacea Jacq., I. hederacea var. integriuscula Gray, I. pandurata (L.) G.F.W. Mey, I. quamoclit L., I. trichocarpa Ell., and from stored sweetpotatoes were all identified under the old name of Cylas formicarius (F). When sweetpotatoes were exposed to weevils that had emerged from these wild hosts, oviposition and development occurred in a normal manner in the potatoes.

Parasites of Weevils: During fall examinations approximately 24 specimens of parasites and parasite cocoons were found in weevil tunnels in wild hosts. The adult parasites were identified as Microbracon punctatus Mues. and the cocoons as Microbracon sp.

Overwintering in Fields: Monthly examinations of infested sweetpotatoes and infested crowns that had been left on the surface of fields at harvest showed a decreasing number of live specimens from month to month.

Observations on Wild Host Plants (Morning-glories) of Sweetpotato Weevils

Winter Survival in Wild Host Plants: Sweetpotato weevils were found unquestionably to have survived the winter in Ipomoea trichocarpa at Sunset, La., and at Thomasville, Ga., and in I. dissecta (Jacq.) Pursh. and I. littoralis (L.) Boiss at Pass Christian, Miss. One live larva was discovered in the crown of an I. trichocarpa plant at Sunset, and 31 plants of 2,910 examined at Thomasville, Ga.,1/ contained live specimens. Two live larvae were recovered from 105 large crowns or roots of I. dissecta, and 19 live larvae and one live pupa were recovered from 28 clumps of I. littoralis at Pass Christian, Miss.1/ At Avery Island, La., 235 roots of I. pandurata were examined, with 168 showing previous tunnelling and 3 dead weevil specimens, but no living specimens were discovered.

1/ These observations were made in cooperation with members of the Sweetpotato Weevil Control Project, Division of Domestic Plant Quarantines, of this Bureau.

Spring Growth of Wild Host Plants: During the spring observations were conducted on a number of farms for the purpose of obtaining data on the time of sprouting of wild hosts and on the abundance of the various varieties. On April 3d only one small specimen of Ipomoea pandurata was found, while on April 15th this species was found growing along fence rows and in fields, with some plants 12 inches long. One plant of I. hederacea var. integriuscula was observed, and a number of seedlings containing only two leaves were located but could not be identified as to species. By April 25th I. quamoclit, I. pandurata, I. hederacea var. integriuscula, and I. trichocarpa were located, with their abundance in the order listed. I. hederacea was discovered on May 8th and 9th. From this date until June 13th, these plants were found in increasing abundance and size, with the first blooms noted on May 20th.

Wild Host Plant Survey on Farms in the Vicinity of Sunset: During July and August a survey was conducted on 14 farms in the vicinity of Sunset, La., to determine (a) distribution and occurrence, (b) relative abundance, and (c) infestation. The farms selected for the survey represented the different local soil types and were situated in an area approximately 12 miles long and 4 miles wide. All of them produce sweetpotatoes every year; some were classed as heavily infested while the status of others was unknown. The results of this survey are shown in the following table:

Table No. 1.--Relative abundance and infestation of wild host plants of the sweetpotato weevil on 14 farms in the vicinity of Sunset, La., during 1941.

Species of Wild Host	Number	Farms Surveyed														
		Dimmick	Beaugh	Thomas	Kemp	Barry	Oge	O. Dimmick	Aaron	Horaist	Savoy	Landry	Williams	Guilbeau	Boudreaux	TOTALS
I. pandurata	Insp.	168	117			143	114					42	21			605
	Infst.	1	67			12	10					0	1			91
I. hederacea var. integriuscula	Insp.	319	74	80	93	99	153	129	24	82	80	62	33	24	247	1,499
	Infst.	0	0	4	0	1	2	0	0	0	0	0	0	0	0	7
I. quamoclit	Insp.	200	93												310	603
	Infst.	0	0												0	0
I. trichocarpa	Insp.	87	1	195	292	110	30	98	115	83	30	113	65	105	365	1,689
	Infst.	0	0	6	0	0	0	0	0	0	0	0	2	0	0	8
I. hederacea	Insp.	7	218	24	69	44	75	34	8	56	25	46	8	6	33	653
	Infst.	0	7	3	0	1	1	0	0	0	0	0	0	0	0	12
I. batatas 2/ (volunteer)	Insp.	50			123					61						234
	Infst.	1			0					0						1
TOTALS	Insp.	781	503	299	454	396	372	261	147	221	135	263	127	135	955	5,049
	Infst.	1	74	13	0	14	13	0	0	0	0	0	3	0	0	118

2/ I. batatas plants not included in totals.

Survey of Wild Host Plants in the Village of Sunset, La.: During September 55 properties, including residences, business places, and vacant lots in the village of Sunset, La., were surveyed for the occurrence of wild host plants of the sweetpotato weevil and for their infestation by this insect. Thirty-nine of these properties contained some Ipomoea plants, with infested Ipomoea found on eight of them. The following varieties were infested: I. trichocarpa on five properties, I. quamoclit on two properties, I. hederacea var. integriuscula on one property, and I. muricata Jacq. on one property. I. purpurea (L.) Roth. was present but not infested.

Infestation on Wild Host Plants in Lake Pontchartrain Marsh: During June a heavy infestation of the sweetpotato weevil was found in Ipomoea sagittata Cav. in the edge of the Lake Pontchartrain Marsh below Slidell, La. Live specimens were again found in this plant at the same location during January, 1942.

Relative Infestation in Wild Host Plants and Sweetpotato Plants in Experiment Plots: Seven species of wild host plants and sweetpotatoes were grown in experiment plots to observe preferences of sweetpotato weevils for them. In determining the relative infestation in these plants the roots, crowns, and all vines for a distance of 1 foot from the soil surface were dissected. The total number and average number of specimens per plant of the various species were:

Plant	Total number of specimens	Average number of specimens per plant
Sweetpotato	527 3/	16.4
Ipomoea hederacea var. integriuscula	585	18.2
I. hederacea	438	13.6
I. quamoclit	783	24.4
I. trichocarpa	266	8.3
I. lacunosa	209	6.5
I. heptaphylla	984	30.7
I. pandurata	19	0.76

3/ In addition, a total of 1402 specimens were found in the potatoes.

Infestation was significantly greater in Ipomoea heptaphylla (Rotth. and Willd.) Voight and significantly less in I. pandurata than in all the others. Significantly greater infestation occurred in I. heptaphylla and I. quamoclit than in sweetpotato plants. It should be pointed out that the I. pandurata plants apparently sustained a severe shock in the transplanting process and they did not make a normal growth or development. This may account, in part, for the very low infestation in these plants.

Infestation of Wild and Ornamental Host Plants in Sweetpotato Field: Five varieties of morning-glories were planted in the sweetpotato plots by removing every seventh sweetpotato plant and setting a morning-glory plant in its place. The five varieties were alternated or repeated in systematic manner. I. bona-nox L. x hederacea Jacq., I. setosa Ker., I. muricata Jacq., and I. lacunosa L. became infested, but Ipomoea sp., a species from the Rio Grande valley, was not infested. Sweetpotato plants on these same rows were more heavily infested than any of the wild or ornamental plants.

Two Additional Wild Hosts Infested: Ipomoea cathartica (Poir) and I. coccinnea L. were recorded infested for the first time during the year.

Flight of Sweetpotato Weevil Adults

Adults Collected at Trap Lights: Two gasoline-burning trap lights were operated in rice fields from July 9th to August 25th at distances ranging from 220 yards to 880 yards from a point where artificially colored adults of the sweetpotato weevil were liberated for dispersal. Sixty-six adults were collected 220 yards from the dispersal point, 22 adults 440 yards away, and 42 adults 880 yards from the dispersal point. A wind-direction indicator operated in conjunction with the lights showed that throughout this period more adults were collected in line with favorable breezes than against such breezes. Very few specimens were collected during nights when sudden changes in temperature or rains occurred.

Adults Collected on Tanglefoot Screens Around Sweetpotato Fields: Forty-five adults were collected between July 17th and August 25th on eight tanglefoot screens placed on three sides of a sweetpotato field. One thousand artificially colored adults were released in this field twice each week during the observations. The screens were discontinued on August 25th and were not operated again until September 9th. Between September 9th and September 30th, 40 of the artificially colored adults were collected on these screens. No liberations were made after the discontinuance of observations in August. These observations indicate that there is a migration or dissemination of the sweetpotato weevil adults from sweetpotato fields of growing and mature plants.

Field Infestations of the Weevil in Sweetpotatoes

The Relation of Crown Infestation to Root Infestation and Yield: For the second year a greater production of sweetpotatoes was recorded from plants with crowns infested by the sweetpotato weevil than from plants with uninfested crowns. There were also more infested sweetpotatoes under the infested crowns than under the uninfested crowns, but this was largely offset by the increased production of the infested crowns. By staking strong and weak sweetpotato plants in the field soon after they were transplanted it was found that more of the strong plants became infested than the weak plants, and the strong plants produced more sweetpotatoes and had a higher infestation of the sweetpotatoes. This information indicates that the stronger, more vigorous plants become more heavily infested than the weaker plants and that these stronger plants produce more potatoes than the weak plants. This seems to refute the theory that sweetpotato weevil infestation imparts some stimulus to the plant, thus increasing production.

Variety Preference Tests: Sweetpotato varieties Unit I Puerto Rico, No. L-4-5, Nancy Hall, and No. 47442 were grown in experiment plots and were observed for weevil preference. Unit I Puerto Rico had significantly less crown infestation than the other varieties, but variety No. L-4-5 had significantly greater root infestation than the others, and there was no difference in root infestation between the other three varieties. The Unit I Puerto Rico variety appeared to have the most desirable growth characteristics for retarding weevil infestation. One hundred and thirty-eight plots of sweetpotato seedlings and crosses, developed by the Louisiana Agricultural Experiment Station and grown in the field near Sunset, La., were examined for weevil infestation and for desirable growth characteristics. It is doubtful if any worthwhile data were obtained in these examinations.

Chemical Control

Laboratory and Small-scale Tests with Poisoned Baits: In laboratory cage tests[4/] 0.32 percent sodium benzoate proved to be the best preservative used with grated sweetpotato poisoned bait. Tests for obtaining the correct proportions of sweetpotato and Paris green for use in baits showed very little difference in mortality produced by baits with the proportions, by weight, of 20 parts of ground sweetpotato and 1 part of Paris green, and proportions ranging from 40 to 60 parts of sweetpotato and 1 part of Paris green. Baits containing wheat bran, sweetpotato pulp, and sweetpotato meal moistened with water were inferior to fresh sweetpotato bait, but when the former baits were moistened with fresh sweetpotato juice the percentage of sweetpotato weevil adult mortality was increased, but not equal to that obtained with the fresh sweetpotato bait.

In large field cages there was no apparent difference in the sweetpotato weevil mortality obtained by using freshly prepared bait, bait that had been stored in a jar for 1 week, and bait that had been scattered in the field for 1 week.

Very poor results were obtained in attempting to poison sweetpotato weevil adults in field headlands and in attempting to protect plants on seed beds during the spring by the application of poison bait. Results were considered satisfactory when baits were applied around old storage banks after the sweetpotatoes were removed and after the bank sites had been cleaned up. Thirteen adults were recovered from four treated banks, whereas 210 were recovered from four corresponding, untreated banks. In the insectary, in the sweetpotato storage room, and in the laboratory, the poisoned bait was applied a number of times to kill adults that had escaped from cages or crates of potatoes, and in each instance excellent mortality was obtained.

4/ This work done at Baton Rouge, La., by C. O. Eddy and E. H. Floyd, of the Louisiana Agricultural Experiment Station.

Poison Bait Applied to Field Plots: An effort was made to protect the growing crop of sweetpotatoes from infestation by the application of poison bait consisting of 20 parts of ground sweetpotato, 1 part of Paris green, and 0.4 percent by weight of sodium benzoate at weekly intervals and at the rate of 120 pounds per acre. Owing to excessive rainfall it was necessary to repeat applications a number of times, so a total of 12 applications was made. Severe injury to the foliage occurred from bait particles lodging on the leaves, but infestation in crowns was significantly less on the poisoned plots than on the untreated plots. There was an observed reduction in infested roots on the poisoned plots and also a reduction in yield on these plots, but neither of the reductions was significant mathematically.

Effect of Poison Bait after Harvest: Poisoned bait consisting of 40 parts ground sweetpotato and 1 part Paris green, by weight, applied to field plots after harvest, produced approximately 18 percent mortality of the sweetpotato weevil adults. When bait was applied to similar plots after a thorough soil surface cleaning of crop remnants the mortality was approximately 35 percent. These experiments indicated that poisoned bait is not very effective in the presence of remnants of the sweetpotato crop but it is considerably more so after this material has been removed. These field experiments, however, did not duplicate the results obtained in large field cages.

The Application of Dusts and Liquid Insecticides to the Growing Crop: Tests were conducted in artificially infested field plots at Baton Rouge[4/] to determine the protection afforded the growing crop by the application of dust mixtures containing synthetic cryolite or calcium arsenate and of sprays containing lead arsenate. There were 12 applications of the dust mixture and 10 applications of spray made between June 25th and August 13th, some of which were necessary because of excessive rainfall. The plots were harvested October 13th, two months after the last insecticide application was made. Calcium arsenate was the best of the materials used, giving complete protection to the crowns, while only 0.76 percent of the roots were infested, compared with 46 percent crown infestation and 38.06 percent root infestation in the untreated plots.

Field Cleaning Methods and Implements

Field Cleaning Methods: Field plot tests were conducted during the fall to determine the best method of harvesting sweetpotatoes so that the fields would be relatively free of remnants of the sweetpotato crop that might serve as food or breeding material for weevils. The three methods under test are (a) customary harvest method, including plowing under the vines, (b) cleaning off vines and removing all scrap sweetpotatoes, and (c) customary harvest method, followed by thoroughly disking the fields. The results of these treatments will not be known until spring, but observations in January 1942 showed little difference in effectiveness between cleaning off the vines and scrap sweetpotatoes and disking the fields after harvest. Both treatments reduced greatly the quantity of green material remaining in the field.

Harvesting Implement Demonstrated: A farm-constructed slide-type vine cutter was given a trial during harvest and was found to cut the vines very effectively. Improvement of this cutter should make it a valuable implement in the field cleaning processes.

Summary

Extensive examinations of known or suspected wild host plants of the sweetpotato weevil growing under natural conditions in various environments afforded by farm lands, sweetpotato fields, village properties, and marsh lands disclosed the presence of important numbers of the insect in several species of wild plants of the morning-glory family. It was found that the insect could overwinter successfully in at least three of the species of recorded wild host plants. These observations show the importance of destroying or otherwise disposing of these wild host plants, as well as the cultivated host plant, as a necessary part of clean-up or eradication operations.

When seven of these species of wild host plants were grown in experimental plots in association with sweetpotato plants, it was found that a significantly greater infestation of the sweetpotato weevil, as measured by the average number of specimens per plant, occurred in three species of wild host plants than in the sweetpotato plants, indicating that under some conditions these species of wild host plants may be preferred to the cultivated host plants.

Experiments to determine the flight ability of the sweetpotato weevil adults resulted in the recovery of 66, 22, and 42 artificially colored individuals at distances of one-eighth, one-fourth, and one-half mile, respectively, from the liberation point, demonstrating that new plantings of sweetpotatoes should be located at some dista nce from old fields, storage sites, or other sources of infestation. The flight ability of the adults was further corroborated by the recovery of numerous artificially colored adults on tanglefoot screens placed on the margin of an infested sweetpotato field.

Poisoned bait tests under various conditions showed that the bait could be used to advantage under restricted conditions, such as around old storage banks and in sweetpotato storage rooms, but that this method is not very effective in protecting the growing crop or as a means of killing the adults remaining in harvested fields.

While the results obtained in applying insecticides to the growing crop showed some promise as a method of control, it does not appear, on the basis of present evidence, that this method will supplant cultural control practices.